Producing Check-Free Beech for Turnings

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Abstract

The effectiveness of presurfacing green beech squares or drying the stock as rounds for reducing surface checking was investigated. Rough-sawed and presurfaced 2-1/2-inch by 2-1I2-inch squares and green rounds 2-1/2 inches in diameter were kiln-dried by a2-1/2-inchthat would cause surface c2-1/2ng in the rough-sawed squares. The squares and rounds were dried to 8 percent moisture content. By presurfacing, surface checking was reduced from an average of 31.2 inches per 3-foot specimen for the rough-sawed squares to an average of 16.4 inches per presurfaced square. Kiln-drying rounds reduced surface checking to an average of 11.4 inches per specimen. These reductions are statistically significant. The yield of acceptable turnings from the kiln-dried wood was 68.7 percent for the rough-sawed squares, 82.1 percent for the presurfaced squares. and 72.1 percent for the rounds. Kiln-drying rounds significantly reduced the amount of bow in the 3-foot specimens.

AMERICAN BEECH (*Fagus grandifolia* Ehrh.) has excellent turning qualities,' and could serve as an alternate species for hard maple or yellow birch for many products. In drying beech lumber thicker than 1 inch or squares 1-1/2 inches and larger, however, surface checking develops, and these failures, though closed in the dry wood, cannot be tolerated in most wood turnings. Experience with oak in lumber form suggests that presurfacing the green wood or converting to rounds for drying will effectively reduce surface checking in subsequent drying.[3] Dry, check-free beech should process with very little difficulty if used where hard maple is now successfully used for turnings.

The purpose here is to summarize the results of a kiln-drying experiment with green beech—rough-sawed squares, presurfaced squares, and rounds. The objective was to demonstrate whether presurfacing the green squares or converting them to rounds before drying would reduce wood losses caused by surface checking.

Procedure

Green beech logs, purchased from a mill in northern Wisconsin, were sawed into 2-5/8-inch flitches that were then ripped into 2-5/8-inch

[1]The authors gratefully acknowledge the cooperation of the Tigerton Lumber Company, Tigerton, Wis., and the South Bend Toy Manufacturing Company, Incorporated, South Bend, Ind.

[2]E. M. Davis, Machining and related characteristics of United States hardwoods. USDA Technical Bulletin No. 1267. Aug. 1962.

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[3]R. C. Rietz and J. A. Jenson, Presurfacing green oak lumber to reduce surface checking. U.S. Forest Service Research Note FPL-0146. Forest Products Laboratory, Madison, Wis. Sept. 1966.

squares. They were then crosscut into three reasonably clear 3-foot-long pieces and were end coated. These three end-matched rough squares were then randomly assigned to three different predrying treatments: 1) rough sawed to 2-1/ 2-inch squares; 2) dressed on all four faces to make 2-1/2-inch squares; and 3) rough turned to rounds 2-1/2 inches in diameter.

Each of the three lots was further randomly divided into two groups to provide replicated kiln runs. The six kiln runs were all carried out in the same forced-air circulation dryer, the order randomized. The bulkpiled, plastic tarpaulin-covered lots were stored, pending drying, in a room at 35° F. and 80 percent relative humidity. The six lots were all kiln-dried in accordance with schedule T8-D5.[4] The squares were edge-to-edge stacked on nominal 1-inch stickers. Superimposed loading was not applied. The air moved parallel to the stickers and across the squares. The load was about 2 feet wide. The 3-foot rounds were bulk-piled in the dry kiln and oriented so that the air moved through the voids parallel to the length of the rounds. The air velocity was estimated as being about 250 feet per minute through the load for all kiln runs.

Kiln schedule T8-D5 was selected because it calls for an initial wet-bulb depression of 10° F.; this ensured surface checking in the rough squares. The kiln schedule was carried out on the basis of the average moisture content of 10 representative pieces. When maximum surface checking was apparent, the total length of surface checks on all four faces of the squares or of the circumference of the rounds was measured by inches and recorded. Before and after drying, the bow of each specimen was measured and recorded.

Results

Drying Time

After 13 days of drying, the average moisture content of the kiln samples (controls) of the two kiln runs of rough-sawed squares was 8.9 percent. After 24 hours of conditioning, which made a total of 14 days of kiln-drying, the average moisture content of the rough-sawed squares was 9.4 percent. The presurfaced squares were also conditioned for 24 hours, and after 15 days the average of the 20 kiln samples for the two kiln runs was 8.4 percent. The rounds after 14 days of drying and 24 hours of conditioning had a moisture content of 8.0 percent. Although the presurfaced squares and rounds required an additional day, their average moisture content was somewhat lower.

[4]U.S. Department of Agriculture, Forest Service, Forest Prod. Lab., Madison, Wis. Dry Kiln Operator's Manual. Agriculture Handbook No. 188. March 1961.

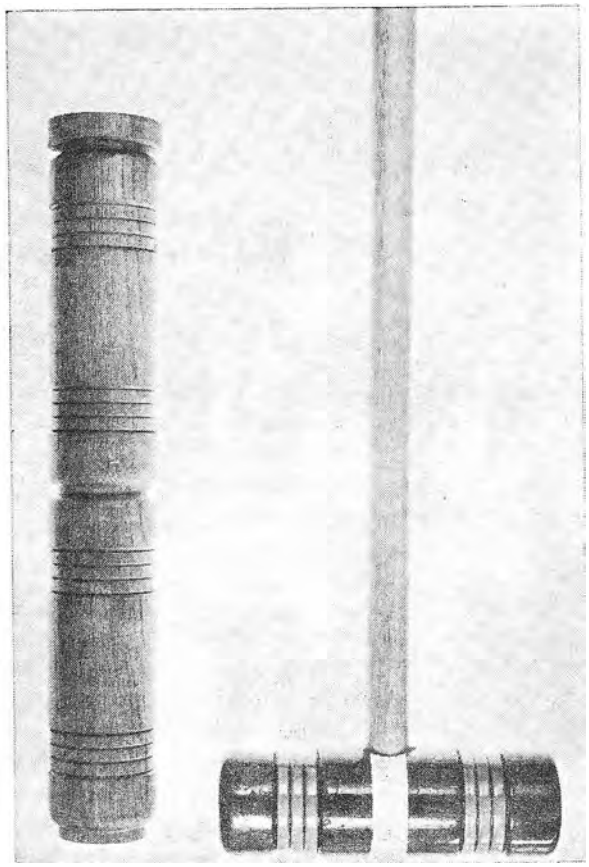

Figure 1. — Croquet mallet heads of beech with a final diameter of 2 inches: Left — two-piece blank turned on an automatic bock-knife lathe; Right — finished croquet mallet head with handle.

Surface Checking

The average length of surface checks per specimen for the two kiln runs of each variable was not statistically different at the 5 percent level; consequently the data were pooled. The average lengths of surface checks for the three variables per 3-foot specimen are shown in the following tabulation:

Specimen	Average length of surface checks (Inches)
Rough-sawed squares	31.2
Presurfaced squares	16.4
Rounds	11.4

The difference between the average length of checks of the presurfaced squares and of the rounds is not significant. The averages for the presurfaced squares and for the rounds are significantly less than for the rough-sawed squares. Presurfacing the green squares or converting them to rounds prior to drying effectively reduced the amount of surface checking that developed in kiln-drying. Because rounds can be stacked for kiln-drying without separating stickers, the increased kiln-holding capacity and reducedVolndling costs may pay for the costs

of converting the green wood to rounds. This makes it possible to obtain less surface checking at very little cost.

Bow

The green rough-sawed and the presurfaced squares had very little warp in them. The bow, in terms of 1/32 inch for the 3-foot specimens, was measured in all specimens before and after drying. The rounds were bowed to some extent after doweling. The maximum bow was determined on each green specimen, and a line was drawn on the round where the measurement was taken. After drying, the bow at this line was again measured, recorded, and the increase in bow determined. The increase in average bow for the squares and for the rounds after kiln-drying is listed here:

Specimen	Increase in average bow (Inch)
Rough-sawed squares	0.116
Presurfaced squares	.126
Rounds	.077

The difference in the average bow between the rough-sawed and the presurfaced squares is not significant. The average bow of the rounds, however, is significantly less than that of the rough-sawed or of the presurfaced squares. Although the green rounds were bowed more than the green squares, the increase in bow with drying was significantly less. The restraint to distortion when rounds are bulk-piled for kiln-drying seems quite evident.

Yield

The kiln-dried squares and rounds were stored after kiln-drying until all of the kiln runs were completed. All of the specimens were then stacked in the same kiln in which they were dried and conditioned at 110° F. and a 7 percent wood equilibrium moisture content (EMC) for 2 weeks. All of the squares and the rounds, including the remaining portions of the kiln samples, were then taken to a turning plant for processing. The squares and the rounds were converted into blanks for croquet mallet heads. The rough-sawed and the presurfaced squares were doweled to about 2-1/8 inches in diameter. They were then crosscut on a table saw to obtain the number of acceptable cuttings, or croquet mallet head blanks. The cuttings were 7-3/4, 13, 15, 17, 19, or 22 inches long and were essentially clear and check free. Some of these cuttings were turned to finished size and pattern on an automatic back-knife lathe and reinspected for acceptance. The 13-inch cutting turned on the lathe is shown in Figure 1. Because all of the finished turnings were satisfactory, the remaining accepted cuttings on the table saw were not turned to finished size and reinspected.

Table 1. — YIELD OF ACCEPTABLE CROQUET MALLET HEADS.

Specimen	Total processed for turning	Total accepted for turning	Yield
	Lineal feet	Lineal feet	Percent
Rough-sawed squares	5,560	3,820	68.7
Presurfaced squares	2,456	2,017	82.1
Rounds	5,488	3,958	72.1

The lineal feet of squares and rounds processed and the lineal feet of accepted cuttings are listed in Table 1.

Presurfaced squares from one of the kiln runs were not included in this yield analysis because the end coating had failed and the yield of acceptable turning was greatly reduced by extended end checks.

Although the surface checking and bow data were analyzed statistically, the yield percentages were not because the acceptable turnings for each specimen could not be determined. The yield of croquet mallet heads was greater when the presurfaced squares and rounds were cut. No explanation for the lower yield from the rounds compared with the yield from the presurfaced squares was evident. Because the rounds had fewer checks than the squares, a greater yield was anticipated.

Interpretation

To air-dry and kiln-dry 2-1/2-inch beech lumber for the production of 2-inch turnings would be hazardous because of the losses caused by surface checking. Usually the green 2-1/2-inch stock would be ripped into 2-1/2-inch squares for drying, but the losses due to surface checking could be prohibitive. Presurfacing the green beech squares or converting them to rounds for drying reduces the hazards of surface checking, minimizing footage losses caused by this drying defect.

A disadvantage of presurfacing is the probable need to saw the lumber somewhat thicker to allow for surfacing, particularly if the surfaced board thickness must be the same as the nominal rough thickness. Because only the tangential faces respond to presurfacing, it is likely that the boards would be surfaced prior to ripping into squares. Another disadvantage is the additional handling and equipment costs involved.

An advantage, in addition to reduced surface checking, is the increased kiln-holding capacity because oversize lumber is eliminated. Converting squares into rounds for drying increases kiln-holding capacity, and warp is restrained. Where turnings are made on automatic lathes, the dry elliptical round requires redoweling.

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